



A Retrospective Study on Child Malnutrition in the Tamale Teaching Hospital, Ghana

Williams Walana^{1*}, Samuel Ekuban Kwabena Acquah¹, Samuel Makinin², Mavis Sarfo², Abdul Bassit Muktar², Ezekiel Kofi Vicar¹, Ernestina Yirkyio³, Mohammed Shaibu Osman³, Alhasan Abdul-Mumin⁴, Sylvanus Kampo⁵, Iddrisu Baba Yabasin⁶ and Juventus Benogle Ziem¹

¹Department of Clinical Microbiology, University for Development Studies, Tamale, Ghana.

²Department of Nursing, University for Development Studies, Tamale, Ghana.

³Department of Nutrition, Tamale Teaching Hospital, Tamale, Ghana.

⁴Department of Paediatrics, University for Development Studies, Tamale, Ghana.

⁵Department of Anesthesia and Intensive Care, University for Development Studies, Tamale, Ghana.

⁶Department of Anesthesia, Tamale Teaching Hospital, Tamale, Ghana.

Authors' contributions

Authors WW, SEKA and JBZ conceived, developed the study protocol and drafted the first manuscript. Authors EKV, SM, MS and ABM extracted the data for the study. Authors SK and IBY cleaned up and analyzed the data. Authors EY, MSO and AAM contributed in the drafting of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JSRR/2016/23095

Editor(s):

(1) Durjoy Majumder, Department of Physiology, West Bengal State University, India.

(2) Shunpu Zhang, Department of Statistics, University of Nebraska – Lincoln, USA.

Reviewers:

(1) Mario Bernardo-Filho, Universidade do Estado do Rio de Janeiro, Brazil.

(2) Isaac Kisiangani, Kenyatta University of Agriculture and Technology, Kenya.

Complete Peer review History: <http://sciencedomain.org/review-history/12986>

Original Research Article

Received 14th November 2015

Accepted 31st December 2015

Published 15th January 2016

ABSTRACT

Introduction: Malnutrition is an essential global public health challenge affecting millions of people. The burden of malnutrition is huge especially among children in developing countries and poverty stricken regions.

Aims: This study investigated the distributions, co-morbidities, and admission outcomes among malnourished children in the paediatric ward of the Tamale Teaching Hospital, Ghana.

Study Design: A retrospective health facility based study was employed.

Place and Duration of Study: The study was conducted in the paediatric ward of the Tamale

*Corresponding author: E-mail: walanawilliams@yahoo.com, wwalana@uds.edu.gh;

Teaching Hospital, from May to June 2015. Data extracted covered the period March 2011 to March 2015.

Methodology: Record books were manually reviewed and data on patients' demography, nutritional status, clinical findings, co-morbid conditions, duration of admission and treatment outcomes were extracted using a structured excel template.

Results: Out of a total 969 children admitted to the ward, 440 (45.4%) were females and 529 (54.6%) were males. Majority of the patients 537 (55.4%) were within the age bracket 7-24 months, with a mean age of 21.2 ± 0.6 months. Approximately 95.3% of the children were severely malnourished. Treatment outcome were generally successful; 534 (58.6%) recovered and were referred to the outpatient clinic for further management, while 220 (23.7%) improved and were discharged. However, the total death rate for the period was 12.8% (119/927). Regarding duration of admission, majority 434 (45.7%) spent between 1-7 days on admission followed by 8-14 days 296 (31.2%). The commonest malnutrition related co-morbidity was malaria, recording 28.1% (236), followed by respiratory tract infections 12.7% (107), gastro-intestinal tract infections 12.0% (101), and sepsis 10.0% (84).

Conclusion: The gradual increase in malnutrition cases recorded in the hospital suggests the existence of relatively high cases in the various communities within Northern Ghana. Thus scaling up community-based malnutritional interventions will be critical in ameliorating the challenges of malnutrition related admissions, particularly among children in the northern part of Ghana.

Keywords: Malnutrition; co-morbidity; admission; Northern Ghana.

DEFINITION OF TERMS

Recovered: This describes patients who were well on discharge but needed continuation of complementary feeding. Such patients were referred to the outpatient clinic for periodic review until they are deemed fit by a nutritionist.

Improved: This refers to patients who were declared fit by a nutritionist on discharge and did not need continuation of complementary food.

Rare complications: This term is used to refer to infrequent diagnoses too few to stand alone during the analysis of the data.

1. INTRODUCTION

Malnutrition literally means "bad nutrition". It is subdivided into two major components, thus over nutrition and under-nutrition [1]. The World Food Program (WFP) defines malnutrition as "a state in which the physical function of an individual is impaired to the point where he or she can no longer maintain adequate bodily performance process such as growth, pregnancy, lactation, physical work and resisting and recovering from diseases" [1,2]. Malnutrition is a pandemic victimizing a substantial group of people among the world's population. Even though there exist global efforts geared toward ameliorating the situation, it still remains a significant public health menace due to the chunk of people affected and the health implications it poses. Malnutrition has been attributed to poverty, big family size, ignorance, illiteracy, climate change, policy and corruption [3]. In poor developing nations, malnutrition is usually caused by food shortages, food prices and distribution, and inadequate breastfeeding [4,5].

According to the World Health Organization (WHO), malnutrition is to a large extent the major contributor to child mortality in the world, currently present in half of all cases [6,7]. Moreover, out of a population of about 842 million folks who have fallen short in terms of access to adequate food, 146 million are children [8]. Among the types of malnutrition identified, severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) are the most common, recording approximately 20 million and 35 million cases yearly among children under five years respectively [8]. The majority of these cases occur in Sub Saharan Africa and Southern Asia. The Report of the Commission for Africa (2005) and Copenhagen Consensus (2008) recognized malnutrition as the biggest challenge facing the world [9]. The crises have been exacerbated by under-investment in nutrition programs, and the effect is that child under-nutrition is now highly prevalent in low income and middle income countries, resulting in a corresponding increase in morbidity, mortality and overall disease burden [10]. It has been estimated that as many as 200

million children under 5 years old fail to reach their full potential in cognitive development because of poverty, poor health and malnutrition. This loss of human potential has been estimated to result in a 20% deficit in adult income and have implications for national development [11].

In spite of countless interventions, malnutrition continues to thrive and remain a major public health concern in many developing countries including Ghana. According to the Ghana demographic and health survey [12], there exist regional variations of malnutrition in Ghana, with some of the poorest indicators found in the Northern part of the country. A 32.4% prevalence rate comparable to the national average of chronic cases of malnutrition was estimated for the northern region. Moreover, a survey conducted by the United Nations Children Fund showed an increase in prevalence in chronic malnutrition rate from 32% to 37% between 2008 and 2011 [13]. Also, a cross-sectional descriptive survey to determine the prevalence of malnutrition in the Tamale metropolis discovered that, there was a 22.6% prevalence rate of malnutrition among children below age five years [14]. The northern region is among the poorest regions in Ghana and poverty is strongly associated with malnutrition. It can therefore be hypothesized that there exist a relatively high rate of child malnutrition associated morbidities in the region. Hence the need to retrospectively determine the pattern of reported cases of malnutrition among children in the paediatric ward of the Tamale Teaching Hospital, Ghana.

2. METHODOLOGY

2.1 Study Area

The study was carried out in the paediatric ward of the Tamale Teaching hospital (TTH). It is the only teaching hospital in the northern part of Ghana and the main referral hospital for the three regions in the northern part of the country. The TTH is the third teaching hospital in Ghana after the Korle -Bu Teaching Hospital and the Komfo Anokye Teaching Hospital. It lies on longitude 9°24' 0" to the north and latitude 0°50 ' 0" to the west. The Hospital is located in the Eastern part of the Tamale Metropolis with a total land surface area of 490,000 square meters, out of which 122,500 square meters has been developed. It is located in a catchment area which has a population of approximately 2.1 million. The hospital was established in 1974 and was formerly known as the Tamale Regional Hospital. It was to provide various health care

services to the people in the Northern, Upper East, Upper West regions and the northern parts of the Brong -Ahafo Region. The hospital also serves patients from neighboring countries including La Cote D'ivoire, Burkina Faso and Togo. In 2002, the Northern Regional Coordinating Council in partnership with the Ghana Health Service (GHS) and Ministry of Health (MOH) upgraded the hospital to the status of a Teaching Hospital. The upgrade was to help with the training of health professionals from the University for Development Studies. The hospital runs six clinical departments including the paediatric unit which attends to children up to 14 years old. The ward has a nutrition unit that admits, treats and provides nutritional care for children with acute malnutrition.

2.2 Study Design

This retrospective health facility-based study was conducted at the nutritional unit of the department of paediatrics of the TTH, reviewing data spanning from March, 2011 to March, 2015. The study population included all malnourished children admitted and treated at the nutrition unit of the TTH. The hospital uses globally standardized methods to screen and diagnose malnutrition cases [15]. The malnutrition status of the patients prior to admission were grouped into severe and moderate by the hospital using anthropometric data such as age-for-height, age-for-weight, mid-upper arm circumference, and clinical presentations such as edema, marasmus and marasmic-kwashiorkor. Records books were manually reviewed and data on patients' demography (age and sex), nutritional status and clinical findings, co-morbid conditions, duration of admission and treatment outcomes were extracted using a structured Microsoft excel template.

2.3 Data Handling and Analysis

The data extracted was double entered to minimize data entry errors. Descriptive statistics was employed in the analysis of the data. Data cleaning and analysis were done using Microsoft Excel 2013 and Statistical Package for Social Sciences (SPSS) version 21.

3. RESULTS

3.1 Age and Gender Distribution of Malnutrition Cases

A total of 969 cases were reviewed for the aforementioned study duration. The incidence of

malnutrition cases peaked among children within the age group 7 to 24 months: 537/969 (55.4%). Children in the age groups 25 to 59 months and 2 to 6 months recorded 219/969 (22.6%) and 140/969 (14.4%) cases respectively. However, the least occurrence of malnutrition cases was seen among neonates 32/969 (3.3%) and those who were 60 months and above 41/969 (4.2%). In relation to gender, cases of malnutrition were higher among males 529 (54.6%) than females 440 (45.4%), as indicated in Table 1.

Table 1. Age and gender distribution of malnutrition cases

Age (Month)	Sex of patient		Total n (%)
	Female n (%)	Male n (%)	
≤1	13(40.6)	19(59.4)	32(3.3)
2-6	72(51.4)	68(48.6)	140(14.4)
7-24	232(43.2)	305(56.8)	537(55.4)
25-59	107(48.9)	112(51.1)	219(22.6)
≥60	16(39.0)	25(61.0)	41(4.2)
Total	440(45.4)	529(54.6)	969(100)

3.2 Yearly Distribution of Malnutrition Cases

The study revealed comparatively low incidence of malnutrition cases in 2011, recording a total of 167 (17.2%) cases. However, Severe Acute Malnutrition (SAM) was higher 137/167 (82.0%) compared to Moderate Acute Malnutrition (MAM) 30/167 (17.8%). Records available covered March to December 2011. In 2012, the number of malnutrition cases increased by 50 from that recorded in 2011. A total of 217 (22.4%) cases were seen, out of which 209/217 (96.3%) were SAM and 8/217 (3.7%) were MAM. A further increase was observed in 2013 in comparison with the past two years. In all, 263 cases were recorded, representing 27.4% of the total number of cases reviewed, and all the cases were SAM. In 2014, a total of 264 cases were reported, consisting of 257/265 (97.0%) SAM and 8/265 (3.0%) MAM. The year 2015 somewhat deviated from the increasing trends observed in the previous years, owing to the fact that data was only complete for the first three months (January to March) as per the study duration. A total of 57(5.9%) SAM cases were seen, there was no reported case of MAM as shown in Fig. 1.

3.3 Cumulative Monthly Distribution of Malnutrition Cases

With reference to Fig. 2, the cumulative monthly distribution of malnutrition cases from 2011 to 2015 revealed that the number of cases were

relatively higher in December 9.49% (92/969), October 9.29% (90/969) and May 9.18% (89/969), and peaked in November 10.11% (98/969). The rest of the months showed varied distributions of malnutrition cases.

3.4 Treatment Outcomes of Malnutrition Cases

For outcomes, data was available for 927 out of the 969 cases. A total 220 out of the 927 patients who attended the facility improved without any complication representing 23.7% of the cases. More than half of the cases 58.6% were referred to the out-patient clinic for further monitoring and discharge while 21 (2.3%) cases were referred out to nearby community clinics and others hospitals for further management. However, 12.8% (119) of the patients died on admission. Other outcomes included clients who defaulted treatment 12/927 (1.3%), absconded 11/927 (1.2%) and discharged against medical advice 1/927(0.1%), Table 2.

Table 2. Treatment outcomes of malnutrition cases

Outcomes	Frequency n (%)
Referred to Out Patient Clinic	543(58.6)
Improved	220(23.7)
Died	119(12.8)
Referred out	21(2.3)
Defaulted	12(1.3)
Absconded	11(1.2)
Discharged against medical advice	1(0.1)
Total	927(100.0)

3.5 Duration of Hospitalization of Malnutrition Cases

The duration of hospitalization was defined as the number of days the patient spent on admission. Generally early discharge was seen; 27(2.8%) of the clients were hospitalized for less than twenty four hours. Almost half of all the clients were discharged within seven days of admission 434 (45.7%). However, 296 (31.2%) and 108(11.4%) stayed between 8 to 14 days and 15 to 21 days respectively. Discharges for 41(4.3%) and 44(4.6 %) patients were done within 22 to 28 days and beyond 29 days respectively (Fig. 3).

3.6 Distribution of Malnutrition Related Co-morbidities

Various malnutrition associated comorbidities were observed among the malnourished

children. The commonest malnutrition related co-morbidity was malaria, 28.1% (236), followed by respiratory tract infections (RTIs) 12.7% (107), gastro-intestinal tract infections (GITs) 12.0% (101), and sepsis 10.0%(84). Urinary tract infections (UTIs) recorded the lowest value 0.6% (5) denoting the least occurrence among the co-morbidities. Other co-morbidities captured included; anemia, immunosuppression/HIV, failure to thrive, neurological disorders, dehydration, cardiac disorders, fever, diarrhea/vomiting and renal disorders (Fig. 4).

4. DISCUSSION

The distribution of malnutrition cases revealed that majority 55.4% (537) of the malnourished children were within the age category 7 to 24 months while the least were seen among

children aged ≤ 1 month 3.3% (32) and ≥ 60 months 4.2% (41). These observations disagree with the Ghana Health Service (GHS) data in Ashanti region which showed that the incidence of malnutrition was lower among children less than one year (1.8%) than those aged 24 to 59 months (2.3%) [16]. The age group 7 to 24 months old is the immediate period after expected exclusive breastfeeding where the child is introduced to complementary and subsequent supplementary foods. It is thought of as a vulnerable period for development of malnutrition because nutritional need for growth and development are greater per kilogram body weight than at any other time in life. Insufficient nutrient intake, poor feeding practices, low quality food and illness resulting from the introduction of pathogens in contaminated foods and feeding bottles have been reported as the

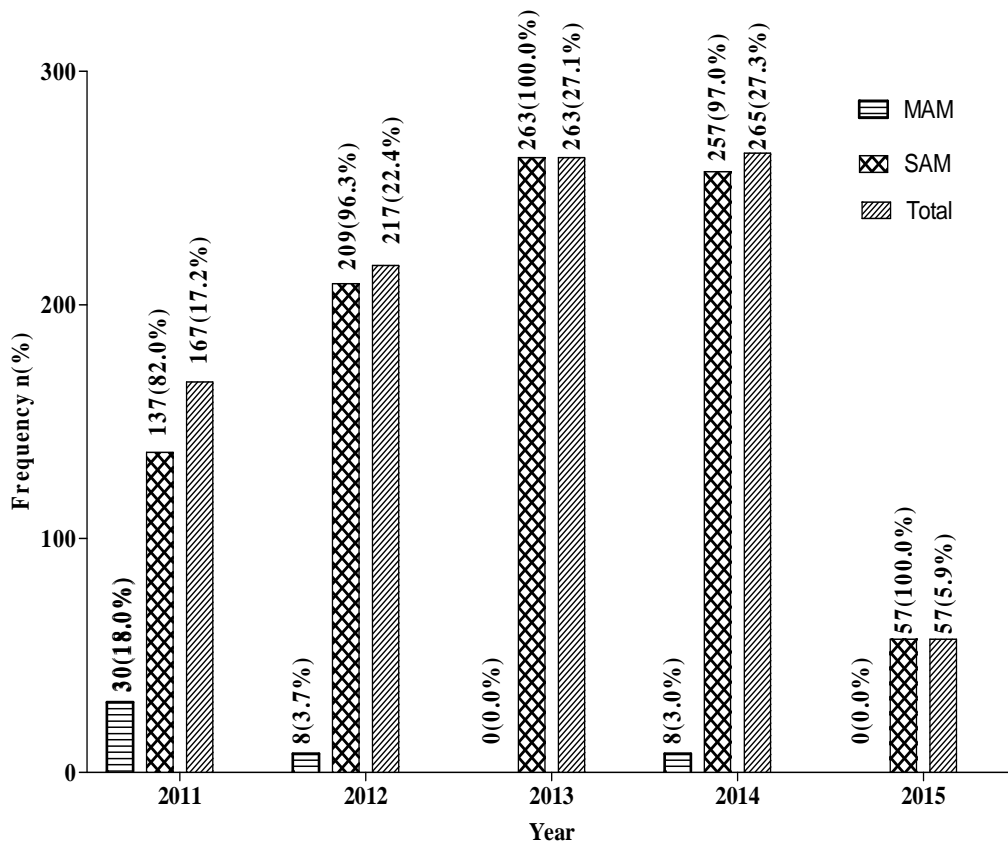


Fig. 1. Yearly distribution of malnutrition cases

* 2011 data covered March to December. ** 2015 data covered January to March. MAM; Moderate Acute Malnutrition; SAM; Severe Acute Malnutrition

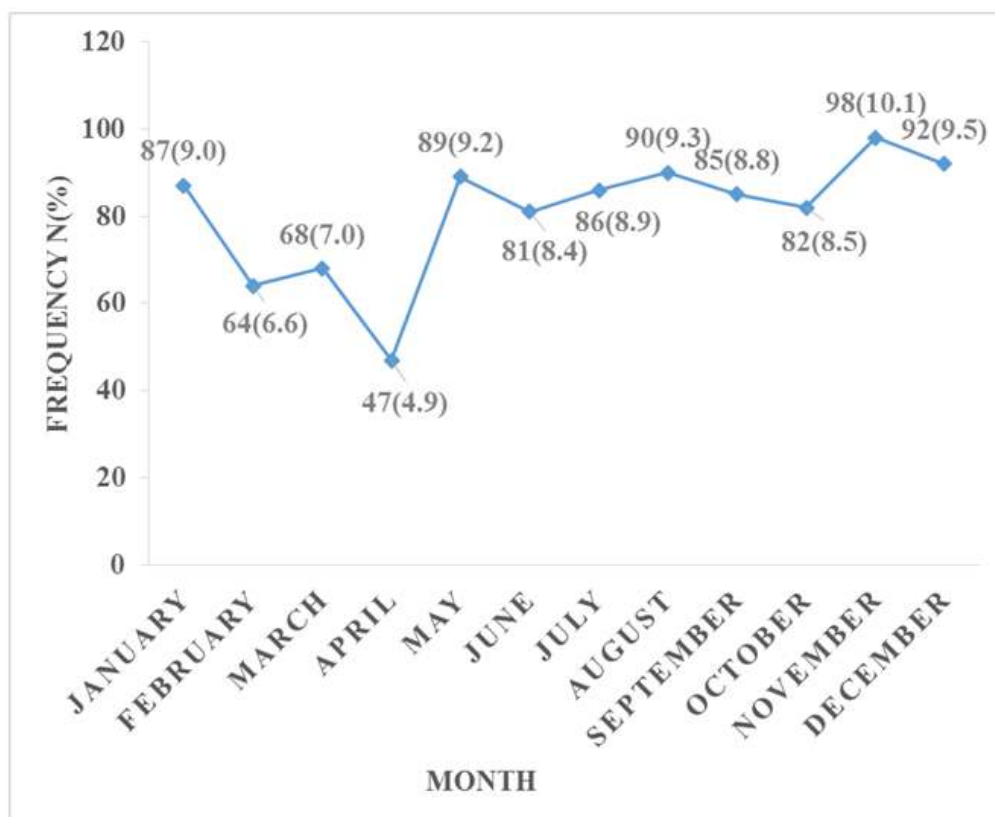


Fig. 2. Cumulative monthly distribution of malnutrition cases

major causes of malnutrition [17]. The most prevalent form of malnutrition observed were severe acute malnutrition (SAM), i.e 923 (95.3%) as against moderate acute malnutrition (MAM), 46 (4.7%), Table 1. This is consistent with the findings of a study in rural Bangladesh where children <24 months had significantly higher levels of SAM than those older than 24 months [18]. The reason for the high incidence of SAM than MAM is unclear, but poor health seeking behavior during early stages of the condition could be critical. This is in consonance with a study conducted among 'underfives' in Bosometwi, in the Ashanti region of Ghana where 23% prevalence of SAM was observed in 32% of all children who were malnourished [19].

The yearly pattern of reported cases revealed a generally increasing trend (Fig. 1). This observation is in congruent with a survey conducted by UNICEF from 2008 to 2011 in Tamale where an increasing trend of chronic malnutrition from a prevalence rate of 32% in 2008 to 37% in 2011 was reported [20,21]. The annual report of Ghana Health Service (GHS)

also pointed out an increasing trend of malnutrition from 2003 to 2006 among under-fives [16]. Even though there were significant decline in stunting, underweight and wasting [22], recent data seem to suggest a decline in efforts towards curbing the menace. It is unclear why the incidence of malnutrition keeps increasing in spite of various measures that have been put in place. However, poverty to some extent may be attributable to this rising trends because the northern region is among the poorest regions in Ghana and since poverty is strongly associated with malnutrition, this observation is somewhat not astonishing but worrisome. A study in Kenya by Ayaya et al., confirms this association [23]. In addition, polygamy is a largely practiced form of marriage in northern Ghana [24]. Polygamy, which usually breeds large family sizes with many children amidst poor socio-economic conditions, contributes immensely to child malnutrition as less attention is given to children with regards to adequate nutrition. Even though the study could not establish the role of polygamy in malnutrition, some previous studies have established a strong association between

children with many siblings and malnutrition [25]. Another study in Rwanda identified polygamy, poor family planning, parental negligence among others as the cause of malnutrition [26]. It has also been established that the number of children a woman have could affect the quality and quantity of food served the children thereby affecting their nutritional status [27,28]. It is however critical to note that the current study was a health facility based, and the cause of malnutrition could be double edged. Thus either the malnutrition was secondary to an underlying disease or infection, or conversely. The relatively high number of cases reported in the hospital could suggest a corresponding higher level of child malnutrition in the communities. Thus community based malnutrition interventions, which target the vulnerable groups will be essential in ameliorating the effects of malnutrition associated diseases in children. Such interventions could use the Ghana School Feeding Program as a vehicle to curb malnutrition among children of school going age.

The cumulative monthly distribution of malnutrition cases peaked in November 10.11 % (98/969). The month May falls within the lean season in northern Ghana and probably informs the relatively high cases recorded therein. It is however unclear why higher cases were recorded in December and October, and peak in November (Fig. 2). This could be a transferred effect from the lean season coupled with seasonal variations due to abundance of rain which usually serve as a predisposing factor to infections such as malaria, diarrhoea and sepsis. This has been revealed in the study as these conditions are among the leading cause of morbidity among the study population (Fig. 4). Seemingly, the results is in consonance with similar work which established a relationship between seasonal variations and child malnutrition [29,30].

The study grouped treatment outcomes of the study population into seven categories; absconded, defaulted, died, discharged against

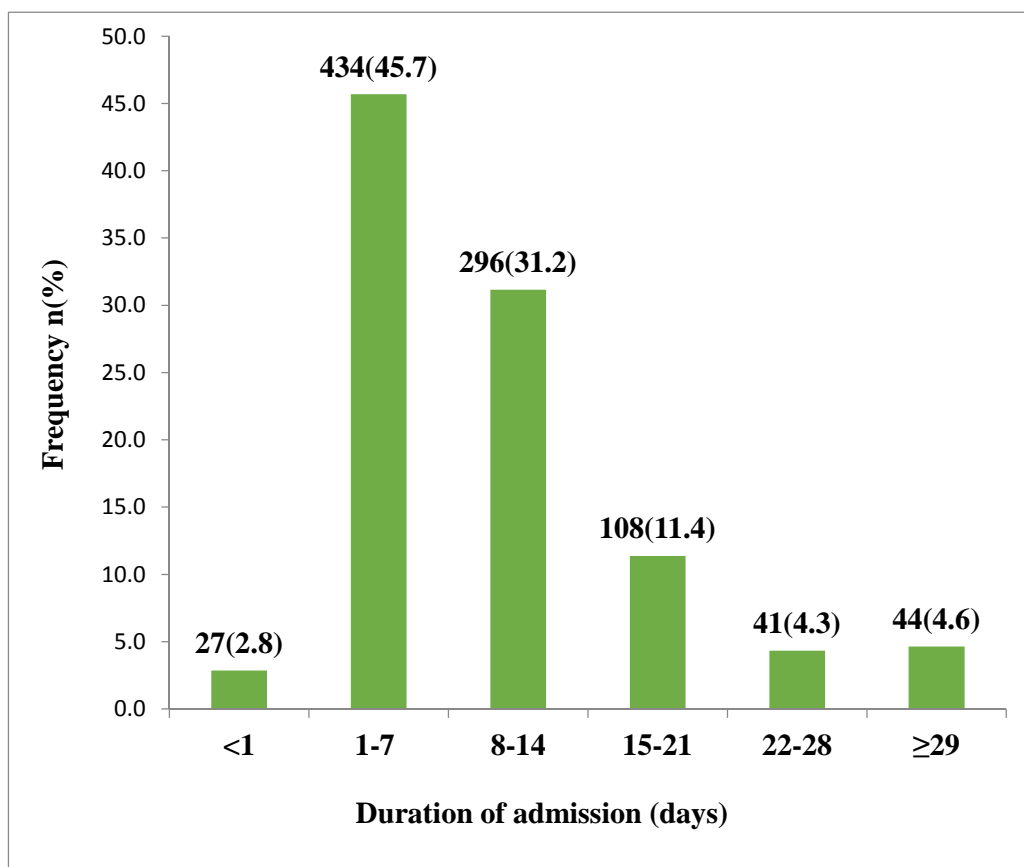


Fig. 3. Duration of hospitalization among malnourished patients

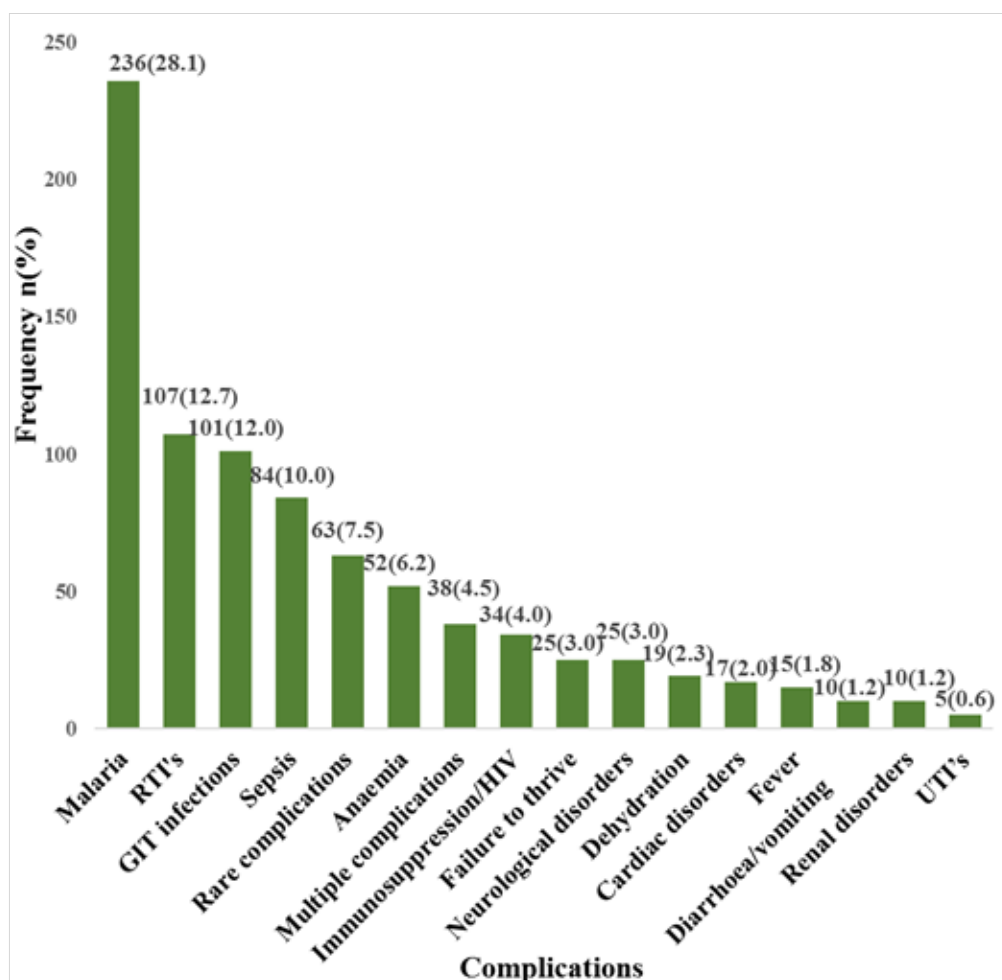


Fig. 4. Distribution of malnutrition related complications

RTI's: Respiratory Tract infections; UTI's: Urinary Tract Infections; HIV: Human Immunodeficiency Virus.

medical advice, improved, referred out and referred to OPC (Out Patient Clinic). Majority of the patients improved and were referred to OPC (Table 2). This corroborates with the findings of a similar study where 67% of OPC cases were referred from inpatient care (IPC) [31]. The reason for this high proportion of referral to the out-patient clinic could be attributed to treatment compliance coupled with no complications after treatment. On the contrary, relatively higher rates of 85% and 65% were observed in similar studies by Chane et al. [32] and Grellety [33] respectively. Several factors could have resulted in this outcome. Key among them is the possible existence of co-morbidities prior to admission, acquisition of nosocomial infection, and lack of logistics and adequate human resource [32,34,35]. Patients who were deemed fit for further management at the community level were

'referred out' (2.3%). The percentage proportion observed in this study was relatively low compared to the 4% reported by Chane et al. [32] in a northern Ethiopian hospital. Most of the 'referred out' patients were those who came from afar and remote places outside the metropolis. Such patients may encounter difficulties presenting for continuity of care owing to distance and financial constraints. Thus, community-based referral is a cost effective measure crucial to curbing child malnutrition [34]. However, in this study, the definition of 'referred out' included few cases which were referred to other major hospitals for treatment.

It was established that of the 969 cases, 1.2% (11) absconded. This is comparatively lower than what was reported by Wammanda and Adeleke in Nigeria were 21.3% of patients absconded

from the ward [36]. Although the outcome of these children are not known, they are more likely to die at home than to survive [37]. The reasons why patients abscond from treatment is not clear, however, this could be explained by the fact that the recovery from malnutrition and its associated health conditions could be regrettably distressing, and given that most of the parents are almost always poor, the cost of such a long stay may be too much for them to bear, as confirmed by Wammanda and Adeleke [36]. Even though discharged against medical advice (DAMA) was uncommon in the present study, it has been estimated that one out of every 65 to 120 discharges from hospitals is a DAMA [38]. A number of reasons could force caregivers or patients to take such drastic decision. Among such reasons are; feeling well enough, dissatisfaction with treatment, inadequate health professional, personal and family problems, marginalization of patients, patient without health insurance, and general dissatisfaction with hospital referred to [39,40]. Factors such as ignorance, poverty, hospital staff and hospital conditions have also been associated with such act [41]. In most developing countries where superstition is deeply rooted among the inhabitants, care givers or patients may attribute the cause of sicknesses to witchcraft and may forcefully seek discharge to consult spiritualists. Discharged against medical advice is not limited to developing countries. Even in the United States of America, an estimated 2% of all hospital discharges are designated as, against medical advice [42], thus a patient chooses to leave the ward before the physician recommends discharge.

The number of admission associated deaths recorded during the period was 119(12.8%). The case fatality rate though lower when compared with other studies, is still on the high side when compared to the WHO scale [43]. A similar study in a Pakistan-based hospital found 13.6% case fatality rate [44]. In another study in northwest Ethiopia, patients hospitalized for severe malnutrition had a case fatality rate of 18% [45], and in Bugando Medical Centre, Tanzania 56.4% deaths were recorded upon grouping treatment outcomes into 'discharge alive' or 'died' [46]. The reason for increasing incidence of mortality among malnourished children is multifactorial. However, the severity of malnutrition and the presence of co-morbid conditions have been shown to confer additional mortality risk among malnourished children [47]. Also delay in seeking healthcare [48] and none-

compliance to treatment have been identified as key contributors to increasing case fatality rate [34].

Data on duration of admission was complete for 950 out of 969 patients. The duration of admission was stratified into days and the outcomes were as followed: less than a day 27 (2.8%), 1 to 7 days 434 (45.7%), 8 to 14 days 296 (31.2%), 15 to 21 days 108 (11.4%), 22 to 28 days 41 (4.3%), and beyond 29 days 44 (4.6%). Majority (79.7%) of the patients spent a maximum of fourteen days on admission. It will be insignificant to attribute this outcome to the number of uncomplicated cases recorded since the degrees of the comorbidities were not captured. However, it will be fair to say treatment compliance was higher as patients were on admission, hence the recovery was rapid [34]. About 8.9% (85) of the patients stayed for more than three weeks, and the reasons could be multifaceted ranging from complication through to delay in seeking medical care.

Considering the diagnosed co-morbidities associated with the patients, some reported with underlining co-morbidities such as HIV, sepsis, malaria, urinary tract infection (UTI), respiratory tract infection (RTI), diarrhea, gastrointestinal tract infection (GIT) among others, while others suffered possibly malnutrition related complications such as anemia. The study revealed malaria as the commonest malnutrition related co-morbidity, recording the highest incidence of 28.1% (236) followed by RTI's 12.7% (107), GIT infections 12.0% (101), and sepsis 10.0% (84). UTI recorded the lowest value 0.6% (5). Other complications observed included; immunosuppression/HIV, failure to thrive, neurological disorders, dehydration, cardiac disorders, fever, diarrhea/vomiting and renal disorders. The increased incidence and severity of infection in malnourished children is largely due to the deterioration of immune function, as established by a study in Columbia that analyzed the cyclical relationship between malnutrition, immune response dysfunction and increased susceptibility to infectious diseases [49].

5. CONCLUSION

The yearly trends of malnutrition cases reported at the Tamale Teaching Hospital is on a positive gradient, coupled with variations in monthly distribution of cases. Malnutrition was found to be most prevalent among children within the age

category 7 to 24 months. Majority of the patients spend a maximum of two weeks on admission. Malaria was identified as the commonest comorbidity associated with malnourished children. Educational and sensitization programs which focus on the blend of breastfeeding and the introduction of supplementary and complementary feeding until a child is 2 years old will be critical in curbing child malnutrition since majority of malnourished children are within the age bracket 7 to 24 months. In addition, educational programs on recipes of supplementary foods which target parents, should focus on the use of locally available and affordable food stuff aimed at enhancing a child's nutritional status, and at the same time minimizing the financial implications which may be associated with malnutrition.

ETHICAL APPROVAL

Ethical clearance for the study was obtained from the Ethical Review Committee of the research unit of the Tamale Teaching Hospital, Tamale. Permission to undertake the study at the facility was granted by the hospital management and the head of the nutrition unit.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Food Program. Food and Nutrition Handbook Rome. World Food Program; 2000.
2. Bain LE, Awah PK, Geraldine N, Kindong NP, Siga Y, Bernard N, et al. Malnutrition in Sub-Saharan Africa: Burden, causes and prospects. *Pan Afr Med J.* 2013; 15(120). DOI: 10.11604/pamj.2013.15.120.2535 PMID: PMC3830470
3. Arslan A, McCarthy N, Lipper L, Asfaw S, Cattaneo A. Adoption and intensity of adoption of conservation farming practices in Zambia. *Agric Ecosyst Environ.* 2013; 187:72-86.
4. Brinkman HJ, de Pee S, Sanogo I, Subran L, Bloem MW. High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *J Nutr.* 2010;140(1):153-161.
5. Struble MB, Aomari LL. Position of the World Dietetic Association: Addressing world hunger, malnutrition, and food insecurity. *J Acad Nutr Diet.* 2003;103(8): 1046.
6. UNICEF/WHO/World Bank. Levels and trends in child malnutrition; 2013. Available:<http://www.who.int/nutgrowthdb/estimates2013/en/> (Accessed on 1 May 2015)
7. Heinrich-Weltzien R, Zorn C, Monse B, Kromeyer-Hauschild K. Relationship between malnutrition and the number of permanent teeth in Filipino 10-to 13-year-olds. *Biomed Res Int;* 2013. Available:<http://dx.doi.org/10.1155/2013/205950>
8. Stiller D. Challenges associated with current intervention strategies and prevention initiatives (2014). Senior Honors Projects. 2014. Paper 372. Available:<http://digitalcommons.uri.edu/srhonorsprog/372>
9. Kuttner R. The Copenhagen Consensus: Reading Adam Smith in Denmark, *Foreign Affairs.* 2008;87(2):78-94.
10. Pridmore P, Carr-Hill R. Addressing the underlying and basic causes of child under nutrition in developing countries: What works and why? From DANIDA's Report. 2009;17-54.
11. Grantham-McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B, et al. International Child Development Steering Group. Developmental potential in the first 5 years for children in developing countries. *The lancet.* 2007;369(9555):60-70.
12. Ghana demographic and health survey 2008. Accra, Ghana: Ghana Statistical Service, Ghana Health Service; 2009. Available:[http://dhsprogram.com/pubs/pdf/FR221/FR221\[13Aug2012\].pdf](http://dhsprogram.com/pubs/pdf/FR221/FR221[13Aug2012].pdf) (Accessed on 6 March 2015)
13. UNICEF and GHS, Multiple Indicator Cluster Survey (MICS), UNICEF, Accra, Ghana; 2011.
14. Addy E, Ibrahim R. Prevalence of malnutrition among children below five years in the tamale metropolis. The official newsletter of the College of Health Sciences, KNUST, Kumasi. 2010;2(1):7-11.
15. WHO & UNICEF. WHO child growth standards and the identification of severe acute malnutrition in infants and children: joint statement by the World Health

- Organization and the United Nations Children's Fund; 2009.
Available:https://extranet.who.int/iris/restricted/bitstream/10665/44129/1/9789241598163_eng.pdf (Accessed on 12 May 2015)
16. Ghana Health Service: The Health Sector In Ghana; Facts and Figures; 2009.
Available:http://www.ghanhealthservice.org/downloads/Facts_and_Figures_2009.pdf (Accessed on 12 May 2015)
 17. Stewart CP, Lannotti L, Dewey KG, Michaelsen KF, Onyango AW. Contextualising complementary feeding in a broader framework for stunting prevention. *Matern Child Nutr.* 2013;9(S2): 27-45.
 18. Roy NC. Use of mid-upper arm circumference for evaluation of nutritional status of children and for identification of high-risk groups for malnutrition in rural Bangladesh. *J Health Popul Nutr.* 2000; 18(3):171-180.
 19. Nyarko LV. Determinants of malnutrition in children less than five years in the Bosomtwe District, Ashanti, Ghana (Doctoral dissertation); 2008.
 20. UNICEF/WHO/World Bank. Levels and trends in child malnutrition. Joint Child Malnutrition Estimates. (UNICEF, New York; WHO, Geneva; The World Bank, Washington DC.); 2011.
 21. Stevens GA, Finucane MM, Paciorek CJ, Flaxman SR, White RA, Donner AJ, et al. Nutrition impact model study group: Trends in mild, moderate, and severe stunting and underweight, and progress towards MDG 1 in 141 developing countries: A systematic analysis of population representative data. *The Lancet.* 2012;380(9844):824-834.
 22. Amugsi DA, Mittelmark MB, Lartey A. An analysis of socio-demographic patterns in child malnutrition trends using Ghana demographic and health survey data in the period 1993–2008. *BMC Public Health.* 2013;13(1):960.
 23. Ayaya SO, Esamai FO, Rotich J, Olwambula AR. Socio-economic factors predisposing under five-year-old children to severe protein energy malnutrition at the Moi Teaching and Referral Hospital, Eldoret, Kenya. *East Afr Med J.* 2004; 81(8):415-421.
 24. Otoo D, Sebel C, Amponsah SK. Mathematical modeling of domestic violence and its trends, case study Tamale Metropolis, Ghana. *JASR.* 2014;4(8):436-447.
 25. Hien NN, Hoa NN. Nutritional status and determinants of malnutrition in children under three years of age in Nghean, Vietnam. *Pak J Nutr.* 2009;8(7):958-964.
 26. Abbott P, Rwirahira J. Against the odds: Achieving the MDGs in Rwanda (No. 3). Rwanda public observatory report; 2012.
 27. Brown K, Dewey K, Allen L. Complementary feeding of young children in developing countries: A review of current scientific knowledge; 1998.
 28. World Food Programme. A manual: Measuring and interpreting malnutrition and mortality. Geneva; 2005.
Available:<http://www.unhcr.org/45f6abc92.pdf> (Accessed on 20 May 2015)
 29. Maleta K, Virtanen SM, Espo M, Kulmala T, Ashorn P. Seasonality of growth and the relationship between weight and height gain in children under three years of age in rural Malawi. *Acta Paediatrica.* 2003; 92(4):491-497.
 30. Sissoko K, van Keulen H, Verhagen J, Tekken V, Battaglini A. Agriculture, livelihoods and climate change in the West African Sahel. *Reg Environ Change.* 2011;11(1):119-125.
 31. Saaka M, Osman SM, Amponsem A, Ziem JB, Abdul-Mumin A, Akanbong P. Treatment outcome of severe acute malnutrition cases at the Tamale teaching hospital. *J Nutr Metab;* 2015.
Available:<http://dx.doi.org/10.1155/2015/641784>
 32. Chane T, Oljira L, Atomesa GE, Agedew E. Treatment outcome and associated factors among under-five children with severe acute malnutrition admitted to therapeutic feeding unit in Woldia hospital, North Ethiopia. *J Nutr Food Sci.* 2014; 4(6):1.
 33. Grellety Y. Management of severe malnutrition in Africa (Doctoral dissertation, University of Aberdeen); 2000.
 34. Collins S. Treating severe acute malnutrition seriously. *Archives of Disease in Childhood.* 2007;92(5):453-461.
 35. Trehan I, O'Hare BA, Phiri A, Heikens GT. Challenges in the management of HIV-infected malnourished children in sub-Saharan Africa. *AIDS research and treatment;* 2012.
DOI: 10.1155/2012/790786
 36. Wammanda RD, Adeleke SI. Protein energy malnutrition: Analysis of admission

- and outcome. *Ann Afr Med.* 2002;1(2):79-83.
37. Gernaat HBPE, Dechering WHJC, Voorhoeve HWA. Mortality in severe protein-energy malnutrition at Nchelenge, Zambia. *J Trop Pediatr.* 1998;44(4):211-217.
38. Devitt AJ. Integrating rhetorical and literary theories of genre. *College English.* 2000; 696-718.
39. Shirani F, Jalili M, Asl-e-Soleimani H. Discharge against medical advice from emergency department: Results from a tertiary care hospital in Tehran, Iran. *Eur J Emerg Med.* 2010;17(6):318-321.
40. Karimi SAP, Saravi BM, Farahabbadi EB, Zamanfar D, Fallah M, Abokheily MA. Studying the rate and causes of discharge against medical advice in hospitals affiliated to Mazandaran University of Medical Sciences. *Materia Socio-Medica.* 2014;26(3):203-207.
DOI: 10.5455/msm.2014.26.203-207
41. Rangraz JF, Rangraz jeddi JM, Rezaeiimofrad M. Patients' reasons for discharge against medical advice in university hospitals of Kashan University of Medical Sciences in 2008. *Hakim Research Journal.* 2010;13(1):33-39.
42. Fiscella K, Meldrum S, Barnett S. Hospital discharge against advice after myocardial infarction: deaths and readmissions. *Am J Med.* 2007;120(12):1047-1053.
43. Benyera O, Hyera FL. Outcomes in malnourished children at a tertiary hospital in Swaziland after implementation of the World Health Organization treatment guidelines. *SAJCH.* 2013;7(4):127-134.
44. Irshad M, Hayat M, Ahmad A, Khalil B, Hussain M. Case fatality rate and etiological factors of malnutrition in children less than 5 years of age. *J. Postgrad. Med Inst.* 2014;28(1):42-48.
45. Amsalu S, Tigabu Z. Risk factors for ever acute malnutrition in children under the age of five: a case-control study. *Ethiop. J. Health Dev.* 2008;22(1):21-25.
46. Ahmed T, Haque R, Ahmed AMS, Petri WA, Cravioto A. Use of metagenomics to understand the genetic basis of malnutrition. *Nutr Res.* 2009;67(suppl 2): 201-206.
47. Black MM. The evidence linking zinc deficiency with children's cognitive and motor functioning. *J Nutr.* 2003;133(5): 1473-1476.
48. Flax VL, Thakwalakwa C, Ashorn U. Perceptions of child body size and health care seeking for undernourished children in Southern Malawi. *Qual Health Res.* 2015;pii:1049732315610522.
49. Rodríguez L, Cervantes E, Ortiz R. Malnutrition and gastrointestinal and respiratory infections in children: A public health problem. *Int J Environ Res Public Health.* 2011;8(4):1174-1205.

© 2016 Walana et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

*The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/12986>*